WASTEWATER DISCHARGE PERMIT: DATA TRACKING AND TECHNICAL FACT SHEET

Permittee: ReEnergy Sterling CT Limited Partnership

PERMIT, ADDRESS, AND FACILITY DATA

PERMIT #: CT0026972 *APPLICATION #s: 201407571*

Mailing Address:						*Location Address:*					
Street:	*10 Exeter Drive*					*Street:*	*10 Exeter Drive*				
City:	*Sterling*	*ST:*	*CT*	*Zip:*	*06377*	*City:*	*Sterling*	*ST:*	*CT*	*Zip:*	*06377*
Contact Name:	*Michael LaPorte*					*DMR Contact*	*Michael LaPorte*				
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PERMIT INFORMATION

DURATION *5 YEAR X__* *10 YEAR __* *30 YEAR*

TYPE *New _* *Reissuance __* *Modification _X*

CATEGORIZATION *POINT (X)* *NON-POINT ( )* *GIS # ____*

NPDES (X) *PRETREAT ()* *GROUND WATER (UIC) ( )* *GROUND WATER (OTHER) ( )*

NPDES MAJOR (MA) ___
NPDES SIGNIFICANT MINOR or PRETREAT SIU (SI) ___
NPDES or PRETREATMENT MINOR (MI) X

PRETREAT SIGNIFICANT INDUS USER (SIU) ___
PRETREAT CATEGORICAL (CIU)

POLLUTION PREVENTION MANDATE ___ *ENVIRONMENTAL EQUITY ISSUE ___*

SIC CODE: 4931 (Electric and other services combined)

COMPLIANCE ISSUES

COMPLIANCE SCHEDULE *YES __* *NO X*

POLLUTION PREVENTION __ *TREATMENT REQUIREMENT __* *WATER CONSERVATION __*

WATER QUALITY REQUIREMENT __ *REMEDIATION __* *OTHER __*

IS THE PERMITTEE SUBJECT TO A PENDING ENFORCEMENT ACTION? NO___ YES _X
On September 18, 2014, DEEP issued Consent Order CO WR IN 14001 to address the elevated levels of zinc in the facility's stormwater and ReEnergy's failure to properly operate and maintain stormwater storage and control system at the facility, including the retention basin between October 2011 and December 2011. The consent order is still open and a consent order modification is pending to update injunctive relief provisions.

OWNERSHIP CODE

*Private _X_* *Federal __* *State __* *Municipal (town only) __* *Other public__*

DEEP STAFF ENGINEER: *Oluwatoyin Fakilede*

PERMIT FEES

Discharge Code	*DSN Number*	*Annual Fee*
1080000	*001 -1*	*$ 2,912.50*

FOR NPDES DISCHARGES

Drainage basin Code: *3500* ***Water Quality Standard:*** *B*

NATURE OF BUSINESS GENERATING DISCHARGE

ReEnergy Sterling CT Limited Partnership was engaged in primarily providing electric services in combination with other services. ReEnergy was a waste to energy facility that used waste tires as a fuel source. The process generated high-pressure steam, which in turn was used to generate electrical power sold directly to the ISO New England Wholesale Market. The facility temporarily ceased energy generation activities in October 2013.

PROCESS AND TREATMENT DESCRIPTION (by DSN)

DSN 001-1: This discharge consists of stormwater runoff and infiltrating groundwater collected in a 2.2 million gallon retention basin. The runoff area of 12.2 acres consists of 9.3 acres of impervious area and 2.9 acres of retention basin area and grass covered embankments. Catch basins on site will use cloth filters for solids removal prior to discharge to the retention basin. The stormwater will undergo equalization in the retention basin before it is pumped out and injected with chemicals for precipitation and flocculation. It will then undergo settling in an 110,000 gallon settling basin prior to filtration and final pH adjustment. The pretreated stormwater in the settling basin will be pumped and discharged into a stormdrain that ties into a drainage swale, for gravity discharge to the Moosup River. Down gradient to Reenergy's facility, there is a groundwater seep that discharges into the same drainage swale. See General Comment section of this fact sheet for further explanation.

RESOURCES USED TO DRAFT PERMIT

__ *Federal Effluent Limitation Guideline_______________*
name of category

__ *Performance Standards*

_ *Federal Development Document*
Name of category

_ *Treatability Manual*

X *Department File Information*

X *Connecticut Water Quality Standards*

X *Anti-degradation Policy*

__ *Coastal Management Consistency Review Form*

X *Other – Explain (See General Comments)*

[1]Ahearn, E.A., 2008, Flow Durations, Low-Flow Frequencies, and Monthly Median Flows for Selected Streams in Connecticut through 2005: U.S. Geological Survey Scientific Investigations Report 2007–5270, 33 p.

[2] United States Department of Agriculture, Natural Resources Conservation Service (2008), Soil Survey of the State of Connecticut.

[3]Carsel, R. F. and Parrish, R. S. (1988), "Developing Joint Probability Distributions of Soil Retention", Water Resources Research, 24 (5): 755-769.

[4] U.S. Geological Survey: Open-File Report 91-481 (1992), "The Stratigraphy and Hydraulic Properties of Tills in Southern New England", pp:36.

BASIS FOR LIMITATIONS, STANDARDS, OR CONDITIONS

X — *Case by Case Determination and Best Professional Judgment*
DSN 001 -1: Aluminum (MIL), cadmium (MIL), copper (MIL), Oil and grease, Total (MIL), pH (MIL), total suspended solids (MDL, MIL) and zinc (MIL)

X — *In order to meet in-stream water quality (See General Comments)*
Aluminum (AML, MDL), aquatic toxicity (MIL), cadmium (AML, MDL), copper (AML, MDL) and zinc (AML, MDL)

AML:- Average Monthly Limit MDL:- Maximum Daily Limit MIL:- Maximum Instantaneous Limit

GENERAL COMMENTS

In July 2010, ReEnergy completed an expansion of its existing retention basin to retain the runoff that is generated on-site from a 100-year storm. ReEnergy reused the collected stormwater as makeup water for its cooling tower and scrubber. The retention basin system was designed to only discharge if a storm event generates more runoff than a 100 year, 24-hour storm or when the basin is full from previous storm(s). Since operations have ceased, ReEnergy no longer uses the stormwater as makeup water. Therefore, in order for the retention basin to maintain a capability of capturing a 100-year, 24-hour storm event, stormwater from the retention basin needs to be discharged routinely. ReEnergy had discharged the stormwater from the retention basin to the sanitary sewer after pretreatment under a Temporary Authorization TA0000174; ReEnergy is currently authorized to discharge the pretreated stormwater to the sanitary sewer under a Miscellaneous General Permit (MGP) No.CTMIU0103. On July 30, 2014, ReEnergy submitted Application No. 2014007571 for permit modification to allow stormwater discharge from its retention basin into the Moosup River following treatment. The MGP will be revoked after this permit modification is issued in accordance with Section 22a-430-3(b)(6)(E) of the Regulations of Connecticut State Agencies (RCSA).

The need for inclusion of water quality based discharge limitations was evaluated consistent with Connecticut Water Quality Standards and criteria, pursuant to 40 CFR 122.44(d). Each parameter was evaluated for consistency with the available aquatic life criteria (acute and chronic) considering the zone of influence allocated to the facility where appropriate. The statistical procedures outlined in the EPA Technical Support Document for Water Quality based Toxics Control (EPA/505/2 90 001) were employed to calculate the need for such limits. Comparison of monitoring data and its inherent variability with the calculated water quality based limits indicates a statistical probability of exceeding such limits. Therefore, water quality based limits were included in the permit for aluminum, cadmium, copper and zinc (the water quality based limits calculation is attached to this fact sheet and labeled Attachment 1).

The existing permit only allows a discharge if a storm event generated more runoff than a 100 year, 24-hour storm. Therefore, the toxicity limits were based on acute in-stream waste concentration (IWC). In this permit modification, the discharge will be more frequent. Therefore, the toxicity limits are based on chronic IWC. As a result of the new IWC, whole effluent toxicity limits were changed from LC50 > 50% to LC50 > 100% and NOAEL > 90% at CTC 38%.

Maximum instantaneous limits for oil and grease, pH and total suspended solids are consistent with the limits in the existing permit. Based on best professional judgment, a maximum daily limit of two-thirds the maximum instantaneous limit was included for total suspended solids, consistent with section 22a-430-4(s)(2) of the RCSA.

This permit modification does not include a monitoring requirement for total residual chlorine. Total residual chlorine is not considered a pollutant of concern for this discharge because chlorine is not used on site.

OTHER COMMENTS

With the exceptions of oil and grease and pH, the sample types for DSN 001-1 were changed from grab to daily composite for better representation of the effluent, over the period of the discharge. As a result, average monthly and maximum daily limits were included. The maximum instantaneous limits for copper and zinc are higher than the limits in the existing permit. Though these limits are higher, they do not contravene the anti-backsliding rule in accordance with Section 22a-430-4(l)(4)(A)(xxiii) of the Regulations of Connecticut State Agencies and Section 402(o)(2) of the Clean Water Act. This is because the circumstances on which the existing permit was based have changed. The existing permit had an average flow *of 475,000 gallons discharge within a 24 hour period. This modification has an average flow of 150,000 gallons discharge within the same period.*

It is ReEnergy's desire to revoke its individual permit if/when it is established that a permit is no longer necessary. In order to do this, ReEnergy must consistently comply with the modified permit's terms and conditions, which would show that the effect of ReEnergy's past industrial activities on stormwater runoff had reduced to meet water quality standards. The monitoring frequencies for aluminum, cadmium, copper and zinc were increased from quarterly to monthly, in order to gather enough data to make a determination about a future permit revocation.

Implementation of the Antidegradation Policy follows a tiered approach pursuant to the federal regulations (40 CFR 131.12) and consistent with the Connecticut Antidegradation Policy included in the Connecticut Water Quality Standards. Tier 1 Antidegradation review applies to all permitted discharge activities to all waters of the state. Tiers 1 and 2 Antidegradation reviews apply to all new or increased discharges to high quality waters and wetlands, while Tiers 1 and 3 Antidegradation reviews apply to all new or increased discharges to outstanding national resource waters.

The receiving stream, Mossup River, was assessed in accordance with Section 305(b) of the Federal Clean Water Act. It is listed as being fully supporting of aquatic life but impaired for recreation. The impairment is as a result of E.coli. The receiving stream has not been designated as high quality water. This permit modification is for an increased discharge, therefore, a Tier 1 Antidegradation Evaluation and Implementation Review was conducted to ensure that existing and designated uses of surface waters and the water quality necessary for their protection are maintained and preserved, consistent with Connecticut Water Quality Standard, Sec.22a-426-8(a)(1). All narrative and numeric water quality standards, criteria and associated policies contained in the Connecticut Water Quality Standards are the basis for the evaluation considering the discharge or activity both independently and in the context of other discharges and activities in the affected water body and considering any impairment listed pursuant to Section 303d for the Federal Clean Water Act or any TMDL established for the water body. The Department has determined that the discharge or activity is consistent with the maintenance, restoration, and protection of existing and designated uses assigned to the receiving water body by considering all relevant available data.

Section 6(A) has a special condition that requires the Permittee to perform all Best Management Practices (BMPs) described in the Operation and Maintenance Plan.

As previously stated, this permit modification allows more frequent discharge. Therefore, a special condition that "The Permittee shall undertake all reasonable measures to properly maintain the storm drainage system at the site to minimize erosion and sedimentation in the drainage swale and the Moosup River" was included in Section 6(B) of modified Permit No.CT0026972. Section 6(C) has a third special condition stating that "Except during and immediately following storm events, the Permittee shall maintain the retention basin level at or below a level of 508.5 feet above the National Geodetic Vertical Datum of 1929 (the operational level). During and immediately following storm events, the Permittee shall pump out accumulated stormwater that is above the operational level, while maintaining compliance with the terms and conditions of this permit modification. The Permittee shall immediately notify the Commissioner of any conditions that may occur to prevent the Permittee from returning the level of the water in the retention basin to the operational level." This is to ensure that the retention basin maintains a capability of capturing a 100-year, 24-hour storm event.

Finally, Section 6(D) of modified Permit No.CT0026972 includes a special condition which states that "The Permittee is authorized to discharge groundwater and stormwater runoff from an inactive industrial site. The Permittee will be required to obtain a permit prior to restarting or initiating production activities to authorize the discharge from an active industrial site." This was included because all evaluation made during this permit modification processing was of discharges from ReEnergy site at its present state of production inactivity. A discharge from an active site could have a different discharge frequency, quality and quantity.

The table below shows the retention basin water elevations and corresponding storage volumes. ReEnergy shall adhere to this table for any future calculations of the retention basin's stormwater storage capability.

EXETER ENERGY
DETENTION BASIN STAGE-STORAGE VOLUMES
AUGUST 2010

Basin Water Elevation (ft)	Storage Volume (cf)	Storage Volume (gal)	Storage Volume (ac-ft)
506.25	0	0	0
506.50	2,408	18,009	0.1
507.00	7,223	54,028	0.2
507.50	19,314	144,465	0.4
508.00	31,404	234,902	0.7
508.50	45,514	340,445	1.0
509.00	59,624	445,988	1.4
509.50	74,991	560,933	1.7
510.00	90,358	675,878	2.1
510.50	106,984	800,240	2.5
511.00	123,610	924,603	2.8
511.50	141,506	1,058,461	3.2
512.00	159,401	1,192,319	3.7
512.50	178,610	1,335,999	4.1
513.00	197,818	1,479,679	4.5
513.50	218,406	1,633,677	5.0
514.00	238,994	1,787,675	5.5
514.50	261,057	1,952,703	6.0
515.00	283,119	2,117,730	6.5
515.10	287,826	2,152,940	6.6
515.50	306,655	2,293,779	7.0
516.00	330,191	2,469,829	7.6
516.85	369,879	2,766,695	8.5

ATTACHMENT 1: WATER QUALITY BASED LIMITS CALCULATION

7Q10 OF THE RECEIVING STREAM

$7Q10\ of\ Moosup\ River\ at\ Plainfield = 7.96\ ft^3/s\ with\ drainage\ area\ of\ 83.6\ mi^2\ (Ahearn, 2008^1)$

$Drainage\ area\ of\ the\ receiving\ stream\ = 42.8\ mi^2\ (USGS\ Connecticut\ Streamstats)$

$$Receiving\ stream\ 7Q10 = 7Q10\ of\ Moosup\ River\ at\ Plainfield\ X\ \frac{Drainage\ area\ of\ Moosup\ River\ at\ Sterling}{Drainage\ area\ of\ Moosup\ River\ at\ Plainfield}$$

$$7Q10 = ZOI = 7.96\ X\ \frac{42.8}{83.6} = 4.07\ \text{cfs} = 4.07\ X\ 646272 = 2{,}630{,}327\ gpd = 109{,}597\ gph$$

There is a groundwater seep that discharges to a drainage swale down gradient from ReEnergy's facility. ReEnergy's discharge will comingle with the groundwater seep prior to discharge to the Moosup River. The seep was observed and sampled in April and August 2014 when groundwater flow was expected to be high and low respectively. Analytical results of the samples collected in April and August showed zinc concentration levels of 300 µg/l and 490 µg/l respectively. The zinc concentration level in the groundwater seep is higher than state's surface water criteria. Therefore, the zone of influence (ZOI) of ReEnergy's permitted discharge was adjusted as described below in view of the elevated zinc levels in the groundwater seep.

In a submittal sent via email on December 18, 2014 by ReEnergy's consultant, Arcadis, the hydraulic gradient and cross − sectional flow area of the zinc plume at the southern regime of ReEnergy's site were determined to be 0.05 and 2,030 ft^2 *respectively. The hydraulic gradient and cross − sectional flow area of the zinc plume at the northern regime of ReEnergy's site were determined to be 0.06 and 4,100* ft^2 *respectively.*
Based on the type of soil at ReEnergy site and surrounding areas upto the Moosup River, the soil's hydraulic conductivity was estimated to be 12.3 µm/sec. (see Appendix A).

Using Darcy's law, the groundwater flux is calculated as follows:

$Q = KiA\ where\ K =\ hydraulic\ conductivity, i = hydraulic\ gradient\ and\ A =\ cross - sectional\ area.$

$$Q_{southern\ regime} = 12.3\ \frac{\mu m}{sec} X\ .05\ X\ 2{,}030\ ft^2 = .004\ \frac{ft^3}{sec}\ \ (1\ \mu m = 3.28084\ X\ 10^{-6}\ ft)$$

$$Q_{northern\ regime} = 12.3\ \frac{\mu m}{sec} X\ .06\ X\ 4{,}100\ ft^2 = .010\ \frac{ft^3}{sec}$$

It is assumed that the flows in the northern and southern regimes are in parallel. Therefore, the groundwater flux Q will be an addition of the fluxes in both regimes. (Note: the actual flux may be less than the calculation below because the total flow from the northern and southern regimes may not necessarily discharge into the Moosup River. However, DEEP staff used the worst case scenario.)

$$Q_e = Q_{southern\ regime} + Q_{northern\ regime} = .004 + .010 = .014\ \frac{ft^3}{sec}$$

$$.014\ \frac{ft^3}{sec} = 377\ gph\ (1\ cfs = 26929.87\ gph)$$

Assuming an average daily limit of 490 µg/l for the groundwater seep, based on analytical data of the groundwater samples collected on two occassions, the ZOI of the groundwater can be back − calculated.

$$AML = LTA\ X\ 95th\ percentile\ multiplier$$

$$LTA = \frac{AML}{95th\ percentile\ multiplier} = \frac{0.49}{1.55} = 0.316$$

$$WLA = \frac{LTA}{99th\ percentile\ multiplier} = \frac{0.316}{0.321} = 0.984$$

$$WLA = 0.984 = \frac{(QC)_d - (QC)_u}{Q_e} = \frac{.065(ZOI + 377) - .005(ZOI)}{377}$$

$where\ (QC)_d\ are\ downstream\ data, (QC)_u are\ upstream\ data, Q_e is\ the\ discharge\ flow\ and$
$Q_d = Q_u + Q_e$

ZOI for groundwater seep = 5,774.38 gph ≈ 5,774 *gph*

ZOI for ReEnergy discharge = 109,597 – 5,774 = 103,823 gph

$The\ Permit\ average\ flow\ limit = 150{,}000\ gpd$
$According\ to\ the\ Permittee, the\ discharge\ duration\ will\ be\ 24\ hours, therefore\ flow\ per\ hour\ will\ be\ 6{,}250\ gph.$

$$DF = \frac{AML + ZOI}{AML}$$

$$DF = \frac{6250+103{,}823}{6250} = 17.61$$

$$IWC = \frac{1}{DF}\ X\ 100\% = 5.68\%$$

The maximum daily limit for toxicity is based on the concentration that will prevent toxicity within the receiving stream as specified in section 22a-430-3(j)(7)(B)(i) of the RCSA.
Chronic toxicity occurs at LC50 X 0.05 and/or NOAEL X 0.15
I.e. toxicity test LC50/0.05 = non-chronically toxic effluent % at ZOI border or
I.e. toxicity test NOAEL/0.15 = non-chronically toxic effluent % at ZOI border

Chronic toxicity limit: LC50 = IWC X 20 and/or NOAEL = IWC X 20/3
For an IWC of 5.68%, chronic toxicity limit = 5.68% X 20 which is higher than 100%.
I.e. chronic toxicity limit = 5.68 X 20/3 = 37.8 % ≈ 38%.

Therefore, the proposed aquatic toxicity limits in this permit modification are:
LC50 ≥ 100% and NOAEL > 90% with a CTC of 38%.

[1]Ahearn, E.A., 2008, Flow Durations, Low-Flow Frequencies, and Monthly Median Flows for Selected Streams in Connecticut through 2005: U.S. Geological Survey Scientific Investigations Report 2007–5270, 33 p.

Prior to the Temporary Authorization issued on 1/10/2014, ReEnergy did not treat its stormwater runoff. Therefore, only the data after February 2014 were used for this evaluation because the data before the implementation of the new treatment system is not representative of the data going forward.

TABLE A: DMR analytical data from February 2014 – July 2014

	Aluminum (µg/l)	*Cadmium (µg/l)*	*Copper (µg/l)*	*Iron (µg/l)*	*Lead (µg/l)*	*Manganese (µg/l)*	*Zinc (µg/l)*
2/13/2014	620	2.0	2.9	57	2.0	160	160
2/14/2014	530	2.0	33	440	2.0	100	130
2/19/2014	---	---	---	---	---	---	130
2/20/2014	480	2.0	45	440	2.0	120	78
2/24/2014	---	---	---	---	---	---	320
2/25/2014	---	---	---	---	---	---	360
2/26/2014	---	---	---	---	---	---	340
2/27/2014	760	2.0	35	530	2.0	120	330
2/28/2014	---	---	---	---	---	---	260
3/3/2014	---	---	---	---	---	---	190
3/4/2014	550	2.0	41	470	2.0	96	200
3/5/2014	---	---	---	---	---	---	160
3/6/2014	---	---	---	---	---	---	170
3/7/2014	---	---	---	---	---	---	140
3/8/2014	---	---	---	---	---	---	150
3/10/2014	---	---	---	---	---	---	98
3/11/2014	380	2.0	57	470	2.0	3400	95
3/11/2014	---	---	---	---	---	---	110
3/12/2014	---	---	---	---	---	---	66
3/13/2014	---	---	---	---	---	---	63
3/14/2014	---	---	---	---	---	---	75
3/17/2014	---	---	---	---	---	---	77
3/18/2014	---	---	43	510	2.0	---	72
3/18/2014	---	---	---	---	---	---	57
3/19/2014	---	---	---	---	---	---	76
3/20/2014	---	---	---	---	---	---	47
3/21/2014	---	---	---	---	---	---	82
3/24/2014	---	---	---	---	---	---	10
3/25/2014	35	2.0	60	550	2.0	110	60
3/25/2014	---	---	---	---	---	---	68
3/26/2014	---	---	---	---	---	---	42
3/27/2014	---	---	---	---	---	---	60
3/28/2014	---	---	---	---	---	---	62
3/31/2014	---	---	---	---	---	---	420
4/1/2014	500	2.0	54	660	2.0	130	370
4/2/2014	---	---	---	---	---	---	360
4/3/2014	---	---	---	---	---	---	390
4/4/2014	---	---	---	---	---	---	380
4/5/2014	---	---	---	---	---	---	400
4/6/2014	---	---	---	---	---	---	360
4/7/2014	---	---	---	---	---	---	400
4/8/2014	440	2.0	23	320	2.0	120	390
4/9/2014	---	---	---	---	---	---	350
4/10/2014	---	---	---	---	---	---	350
4/11/2014	---	---	---	---	---	---	280
4/12/2014	---	---	---	---	---	---	320
4/13/2014	---	---	---	---	---	---	370
4/14/2014	---	---	---	---	---	---	370
4/15/2014	320	2.0	77	560	4.4	180	320
4/16/2014	---	---	---	---	---	---	350
4/17/2014	---	---	---	---	---	---	460
4/18/2014	---	---	---	---	---	---	330
4/19/2014	---	---	---	---	---	---	340
4/20/2014	---	---	---	---	---	---	370
4/21/2014	---	---	---	---	---	---	280
4/22/2014	380	2.0	28	280	2.0	180	290
4/23/2014	---	---	---	---	---	---	390
4/24/2014	---	---	---	---	---	---	210

4/25/2014	---	---	---	---	---	---	190
4/26/2014	---	---	---	---	---	---	240
4/27/2014	---	---	---	---	---	---	210
4/28/2014	---		---	---	---	---	160
4/29/2014	300	2.0	69	69	2.0	190	200
4/30/2014	---	---	---	---	---	---	170
5/1/2013	---	---	---	---	---	---	170
5/2/2014	---	---	---	---	---	---	280
5/3/2014	---	---	---	---	---	---	320
5/14/2014	---	---	---	---	---	---	280
5/15/2014	280	---	38	540	6.6	210	240
5/16/2014	---	---	---	---	---	---	310
5/17/2014	---	---	---	---	---	---	260
5/20/2014	---	---	---	---	---	---	240
5/21/2014	---	---	---	---	---	---	230
5/22/2014	490	---	46	590	2.0	210	280
5/23/2014	---	---	---	---	---	---	200
5/27/2014	---	---	---	---	---	---	160
5/28/2014	---	---	---	---	---	---	160
5/29/2014	740	---	18	440	2.0	250	200
7/8/2014	1400	2.0	8.8	420	2.0	3900	960
$Cv = \frac{SD}{mean}$	0.58 ≈ 0.60	Use 0.6	0.51 ≈ 0.50	0.38 ≈ 0.40	0.52 ≈ 0.50	2.02 ≈ 2.0	0.61 ≈ 0.60

TABLE B: AVERAGE OF THE UPSTREAM MOOSUP RIVER CONCENTRATION DATA BASED ON DATA COLLECTED ON APRIL 17, 2014 AND AUGUST 27, 2014 (μg/l)			
	4/17/2014	8/27/2014	Average
Aluminum	---	25	25
Cadmium	0.5	0.5	0.5
Copper	1.5	1.5	1.5
Iron	240	500	370
Lead	0.5	0.5	0.5
Manganese	20	20	20
Zinc	5	5	5

TABLE C: CONNECTICUT WATER QUALITY CRITERIA (CLASS B FRESHWATER)			
	Aquatic Life (Acute (μg/l))	Aquatic Life (Chronic (μg/l))	Human Health (μg/l)
Aluminum	750	87	---
Cadmium	1.0	0.125	10,769
Copper	14.3	4.8	---
Iron	---	1000*	---
Lead	30	1.2	15
Manganese	---	---	100*,[1]
Zinc	65	65	26,000
∗ EPA National Recommended Water Quality Criteria [1] Only applicable to marine waters			

TABLE D: REASONABLE POTENTIAL EVALUATION (This analysis basically compares the projected maximum concentration in the effluent with the applicable water quality standard. When the projected maximum concentration is lower than the waste load allocation, this indicates that there is no potential for the discharge to exceed the water quality criteria. When the projected maximum concentration is higher than the waste load allocation, this indicates that there is potential for the discharge to exceed the water quality criteria and therefore limits are needed in the permit.)					
$WLA = Waste\ load\ allocation,\ (QC)_d = Downstream\ data,\ (QC)_u = Upstream\ data\ and\ Q_e = the\ discharge\ flow$ $(refer\ to\ the\ ZOI\ calculation\ above\ for\ the\ downstream\ and\ effluent\ flow\ data)$					
	$Maximum\ projected\ concentration\ in\ effluent = Maximum\ measured\ concentration\ in\ effluent\ X\ multiplier\ in\ Table\ 3-1\ below$	$WLA_{acute} = \frac{(QC)_d - (QC)_u}{Q_e}$	$WLA_{chronic} = \frac{(QC)_d - (QC)_u}{Q_e}$	$** WLA_{health} = \frac{(QC)_d - (QC)_u}{Q_e}$	$Is\ there\ reasonable\ potential\ to\ exceed\ WQC?$
Aluminum	1400 X 2.5 = 3500.0	12,793.47	1,116.92	---	Yes
* Cadmium	2 X 2.7 = 5.4	9.31	2.20	368,534.75	Yes
Copper	77 X 2.1 = 161.7	226.93	59.62	---	Yes
Iron	660 X 1.9 = 1254.0	---	13,126.53	---	No
Lead	6.6 X 2.1 = 13.86	520.04	12.83	496.74	No
Manganese	3900 X 8.2 = 31980	---	---	---	NA
Zinc	960 X 2.3 = 2208	1061.70	1061.70	889,641.24	Yes
$(QC)_d$ are downstream data, $(QC)_u$ are upstream data, Q_e is the discharge flow and $Q_d = Q_u + Q_e$ * The upstream concentration of cadmium was assumed to be zero for the $WLA_{chronic}$ calculation ** Harmonic mean flow of 2 X ZOI was assumed for the WLA_{health} calculation					

TABLE E: PERMIT LIMITS CALCULATION					
$LTA = Long\ term\ average,\ AML = Average\ monthly\ limit\ and\ MDL = Maximum\ daily\ limit$					
	$LTA_{acute} = WLA_{acute}\ X\ 99th\ percentile\ multiplier\ in\ the\ attached\ Table\ 5-1\ (\mu g/l)$	$LTA_{chronic} = WLA_{chronic}\ X\ 99th\ percentile\ multiplier\ in\ the\ attached\ Table\ 5-1\ (\mu g/l)$	$Governing\ LTA$	$AML = LTA\ X\ 95th\ percentile\ multiplier\ in\ the\ attached\ Table\ 5-2\ (\mu g/l)$	$MDL = LTA\ X\ 99th\ percentile\ multiplier\ in\ the\ attached\ Table\ 5-2\ (\mu g/l)$
Aluminum	12793.47 X 0.321 = 4106.70	1116.92 X 0.527 = 588.62	588.62	588.62 X 1.55 = 912.36	588.62 X 3.11 = 1830.61
Cadmium	9.31 X 0.321 = 2.99	2.2 X 0.527 = 1.16	1.16	1.16 X 1.55 = 1.80	1.16 X 3.11 = 3.61
Copper	226.93 X 0.373 = 84.64	59.62 X 0.581= 34.64	34.64	34.64 X 1.45 = 50.23	34.64 X 2.68 = 92.84
Zinc	1061.70 X 0.321 = 340.81	1061.70 X 0.527 = 559.52	340.81	340.81 X 1.55 = 528.26	340.81 X 3.11 = 1059.92

Table 3-1. Reasonable Potential Multiplying Factors: 99% Confidence Level and 99% Probability Basis

Number of Samples	Coefficient of Variation 0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
1	1.6	2.5	3.9	6.0	9.0	13.2	18.9	26.5	36.2	48.3	63.3	81.4	102.8	128.0	157.1	190.3	227.8	269.9	316.7	368.3
2	1.4	2.0	2.9	4.0	5.5	7.4	9.8	12.7	16.1	20.2	24.9	30.3	36.3	43.0	50.4	58.4	67.2	76.6	86.7	97.5
3	1.4	1.9	2.5	3.3	4.4	5.6	7.2	8.9	11.0	13.4	16.0	19.0	22.2	25.7	29.4	33.5	37.7	42.3	47.0	52.0
4	1.3	1.7	2.3	2.9	3.8	4.7	5.9	7.2	8.7	10.3	12.2	14.2	16.3	18.6	21.0	23.6	26.3	29.1	32.1	35.1
5	1.3	1.7	2.1	2.7	3.4	4.2	5.1	6.2	7.3	8.6	10.0	11.5	13.1	14.8	16.6	18.4	20.4	22.4	24.5	26.6
6	1.3	1.6	2.0	2.5	3.1	3.8	4.6	5.5	6.4	7.5	8.6	9.8	11.1	12.4	13.8	15.3	16.8	18.3	19.9	21.5
7	1.3	1.6	2.0	2.4	2.9	3.6	4.2	5.0	5.8	6.7	7.7	8.7	9.7	10.8	12.0	13.1	14.4	15.6	16.9	18.2
8	1.2	1.5	1.9	2.3	2.8	3.3	3.9	4.6	5.3	6.1	6.9	7.8	8.7	9.6	10.6	11.6	12.6	13.6	14.7	15.8
9	1.2	1.5	1.8	2.2	2.7	3.2	3.7	4.3	5.0	5.7	6.4	7.1	7.9	8.7	9.6	10.4	11.3	12.2	13.1	14.0
10	1.2	1.5	1.8	2.2	2.6	3.0	3.5	4.1	4.7	5.3	5.9	6.6	7.3	8.0	8.8	9.5	10.3	11.0	11.8	12.6
11	1.2	1.5	1.8	2.1	2.5	2.9	3.4	3.9	4.4	5.0	5.6	6.2	6.8	7.4	8.1	8.8	9.4	10.1	10.8	11.5
12	1.2	1.4	1.7	2.0	2.4	2.8	3.2	3.7	4.2	4.7	5.2	5.8	6.4	7.0	7.5	8.1	8.8	9.4	10.0	10.6
13	1.2	1.4	1.7	2.0	2.3	2.7	3.1	3.6	4.0	4.5	5.0	5.5	6.0	6.5	7.1	7.6	8.2	8.7	9.3	9.9
14	1.2	1.4	1.7	2.0	2.3	2.6	3.0	3.4	3.9	4.3	4.8	5.2	5.7	6.2	6.7	7.2	7.7	8.2	8.7	9.2
15	1.2	1.4	1.6	1.9	2.2	2.6	2.9	3.3	3.7	4.1	4.6	5.0	5.4	5.9	6.4	6.8	7.3	7.7	8.2	8.7
16	1.2	1.4	1.6	1.9	2.2	2.5	2.9	3.2	3.6	4.0	4.4	4.8	5.2	5.6	6.1	6.5	6.9	7.3	7.8	8.2
17	1.2	1.4	1.6	1.9	2.1	2.5	2.8	3.1	3.5	3.8	4.2	4.6	5.0	5.4	5.8	6.2	6.6	7.0	7.4	7.8
18	1.2	1.4	1.6	1.8	2.1	2.4	2.7	3.0	3.4	3.7	4.1	4.4	4.8	5.2	5.6	5.9	6.3	6.7	7.0	7.4
19	1.2	1.4	1.6	1.8	2.1	2.4	2.7	3.0	3.3	3.6	4.0	4.3	4.6	5.0	5.3	5.7	6.0	6.4	6.7	7.1
20	1.2	1.3	1.6	1.8	2.0	2.3	2.6	2.9	3.2	3.5	3.8	4.2	4.5	4.8	5.2	5.5	5.8	6.1	6.5	6.8

Table 5-1. Back Calculations of Long-Term Average

Acute

CV	WLA Multipliers $e^{[0.5\sigma^2 - z\sigma]}$ 95th Percentile	99th Percentile
0.1	0.853	0.797
0.2	0.736	0.643
0.3	0.644	0.527
0.4	0.571	0.440
0.5	0.514	0.373
0.6	0.468	0.321
0.7	0.432	0.281
0.8	0.403	0.249
0.9	0.379	0.224
1.0	0.360	0.204
1.1	0.344	0.187
1.2	0.330	0.174
1.3	0.319	0.162
1.4	0.310	0.153
1.5	0.302	0.144
1.6	0.296	0.137
1.7	0.290	0.131
1.8	0.285	0.126
1.9	0.281	0.121
2.0	0.277	0.117

$$LTA_{a,c} = WLA_{a,c} \cdot e^{[0.5\sigma^2 - z\sigma]}$$

where $\sigma^2 = \ln[CV^2 + 1]$,
$z = 1.645$ for 95th percentile occurrence probability, and
$z = 2.326$ for 99th percentile occurrence probability

Chronic
(4-day average)

$$LTA_c = WLA_c \cdot e^{[0.5\sigma_4^2 - z\sigma_4]}$$

where $\sigma_4^2 = \ln[CV^2/4 + 1]$,
$z = 1.645$ for 95th percentile occurrence probability, and
$z = 2.326$ for 99th percentile occurrence probability

CV	WLA Multipliers $e^{[0.5\sigma_4^2 - z\sigma_4]}$ 95th Percentile	99th Percentile
0.1	0.922	0.891
0.2	0.853	0.797
0.3	0.791	0.715
0.4	0.736	0.643
0.5	0.687	0.581
0.6	0.644	0.527
0.7	0.606	0.481
0.8	0.571	0.440
0.9	0.541	0.404
1.0	0.514	0.373
1.1	0.490	0.345
1.2	0.468	0.321
1.3	0.449	0.300
1.4	0.432	0.281
1.5	0.417	0.264
1.6	0.403	0.249
1.7	0.390	0.236
1.8	0.379	0.224
1.9	0.369	0.214
2.0	0.360	0.204

Table 5-2. Calculation of Permit Limits

CV	LTA multipliers $e^{[z\sigma - 0.5\sigma^2]}$ 95th Percentile	LTA multipliers $e^{[z\sigma - 0.5\sigma^2]}$ 99th Percentile
0.1	1.17	1.25
0.2	1.36	1.55
0.3	1.55	1.90
0.4	1.75	2.27
0.5	1.95	2.68
0.6	2.13	3.11
0.7	2.31	3.56
0.8	2.48	4.01
0.9	2.64	4.46
1.0	2.78	4.90
1.1	2.91	5.34
1.2	3.03	5.76
1.3	3.13	6.17
1.4	3.23	6.56
1.5	3.31	6.93
1.6	3.38	7.20
1.7	3.45	7.63
1.8	3.51	7.95
1.9	3.56	8.26
2.0	3.60	8.55

Maximum Daily Limit

$$MDL = LTA \bullet e^{[z\sigma - 0.5\sigma^2]}$$

where $\sigma^2 = ln[CV^2 + 1]$,
$z = 1.645$ for 95th percentile occurrence probability, and
$z = 2.326$ for 99th percentile occurrence probability

Average Monthly Limit

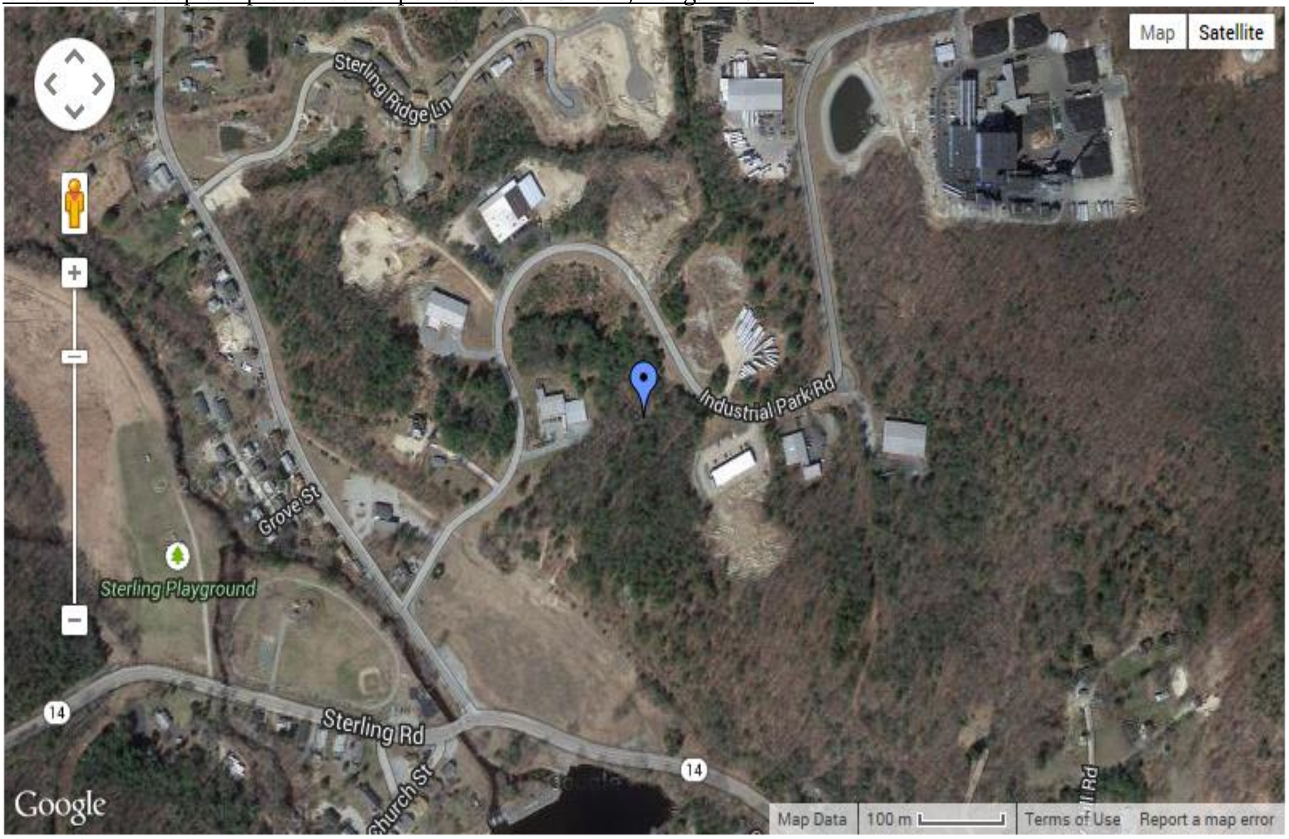
$$AML = LTA \bullet e^{[z\sigma_n - 0.5\sigma_n^2]}$$

where $\sigma_n^2 = ln[CV^2 / n + 1]$,
$z = 1.645$ for 95th percentile,
$z = 2.326$ for 99th percentile, and
n = number of samples/month

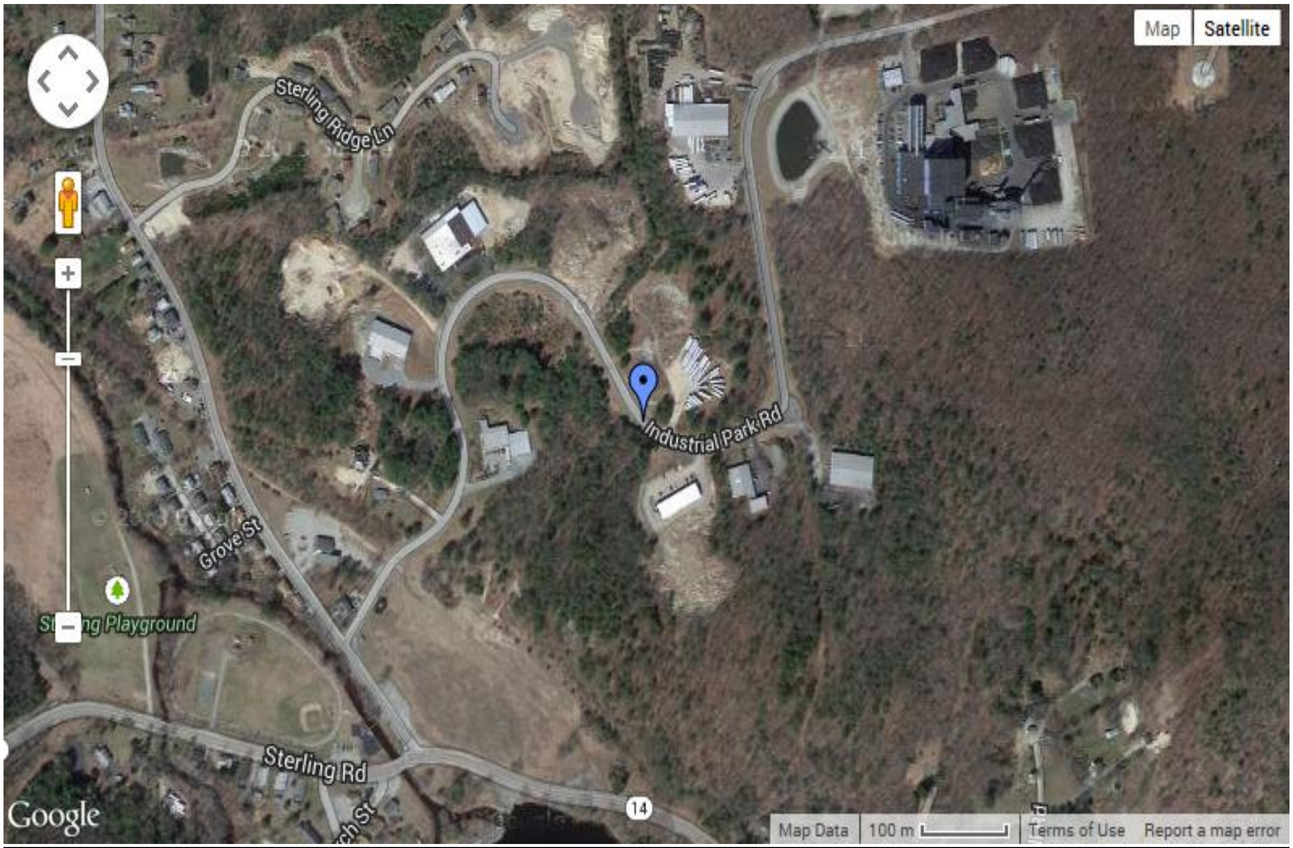
CV	LTA Multipliers $e^{[z\sigma_n - 0.5\sigma_n^2]}$ 95th Percentile					99th Percentile				
	n=1	n=2	n=4	n=10	n=30	n=1	n=2	n=4	n=10	n=30
0.1	1.17	1.12	1.08	1.06	1.03	1.25	1.18	1.12	1.08	1.04
0.2	1.36	1.25	1.17	1.12	1.06	1.55	1.37	1.25	1.16	1.09
0.3	1.55	1.38	1.26	1.18	1.09	1.90	1.59	1.40	1.24	1.13
0.4	1.75	1.52	1.36	1.25	1.12	2.27	1.83	1.55	1.33	1.18
0.5	1.95	1.66	1.45	1.31	1.16	2.68	2.09	1.72	1.42	1.23
0.6	2.13	1.80	1.55	1.38	1.19	3.11	2.37	1.90	1.52	1.28
0.7	2.31	1.94	1.65	1.45	1.22	3.56	2.66	2.08	1.62	1.33
0.8	2.48	2.07	1.75	1.52	1.26	4.01	2.96	2.27	1.73	1.39
0.9	2.64	2.20	1.85	1.59	1.29	4.46	3.28	2.48	1.84	1.44
1.0	2.78	2.33	1.95	1.66	1.33	4.90	3.59	2.68	1.96	1.50
1.1	2.91	2.45	2.04	1.73	1.36	5.34	3.91	2.90	2.07	1.56
1.2	3.03	2.56	2.13	1.80	1.39	5.76	4.23	3.11	2.19	1.62
1.3	3.13	2.67	2.23	1.87	1.43	6.17	4.55	3.34	2.32	1.68
1.4	3.23	2.77	2.31	1.94	1.47	6.56	4.86	3.56	2.45	1.74
1.5	3.31	2.86	2.40	2.00	1.50	6.93	5.17	3.78	2.58	1.80
1.6	3.38	2.95	2.48	2.07	1.54	7.29	5.47	4.01	2.71	1.87
1.7	3.45	3.03	2.56	2.14	1.57	7.63	5.77	4.23	2.84	1.93
1.8	3.51	3.10	2.64	2.20	1.61	7.95	6.06	4.46	2.98	2.00
1.9	3.56	3.17	2.71	2.27	1.64	8.26	6.34	4.68	3.12	2.07
2.0	3.60	3.23	2.78	2.33	1.68	8.55	6.61	4.90	3.26	2.14

Onsite retention basin: - Lat. 41.71829º, Long. -71.82999º

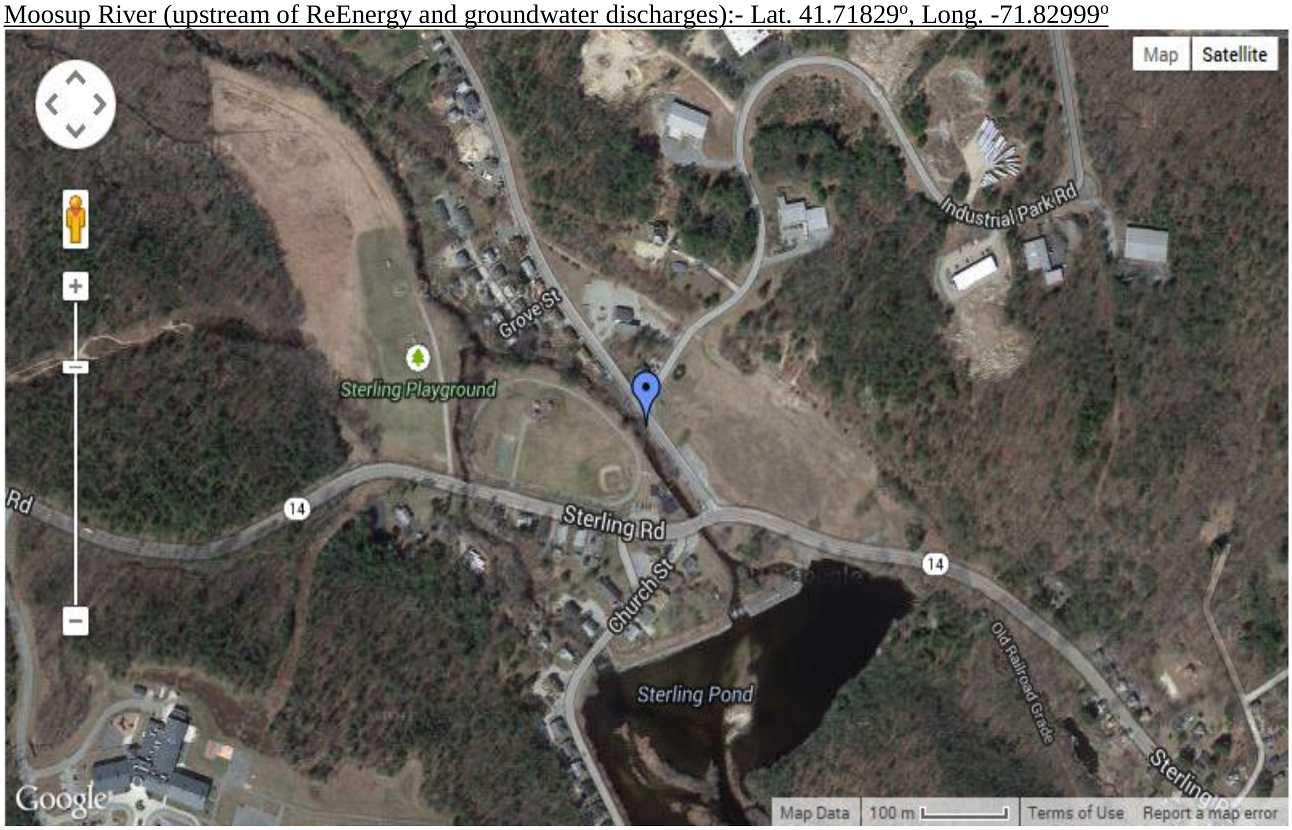
Groundwater seep sample collection point: - Lat. 41.7101º, Long. -71.8268º



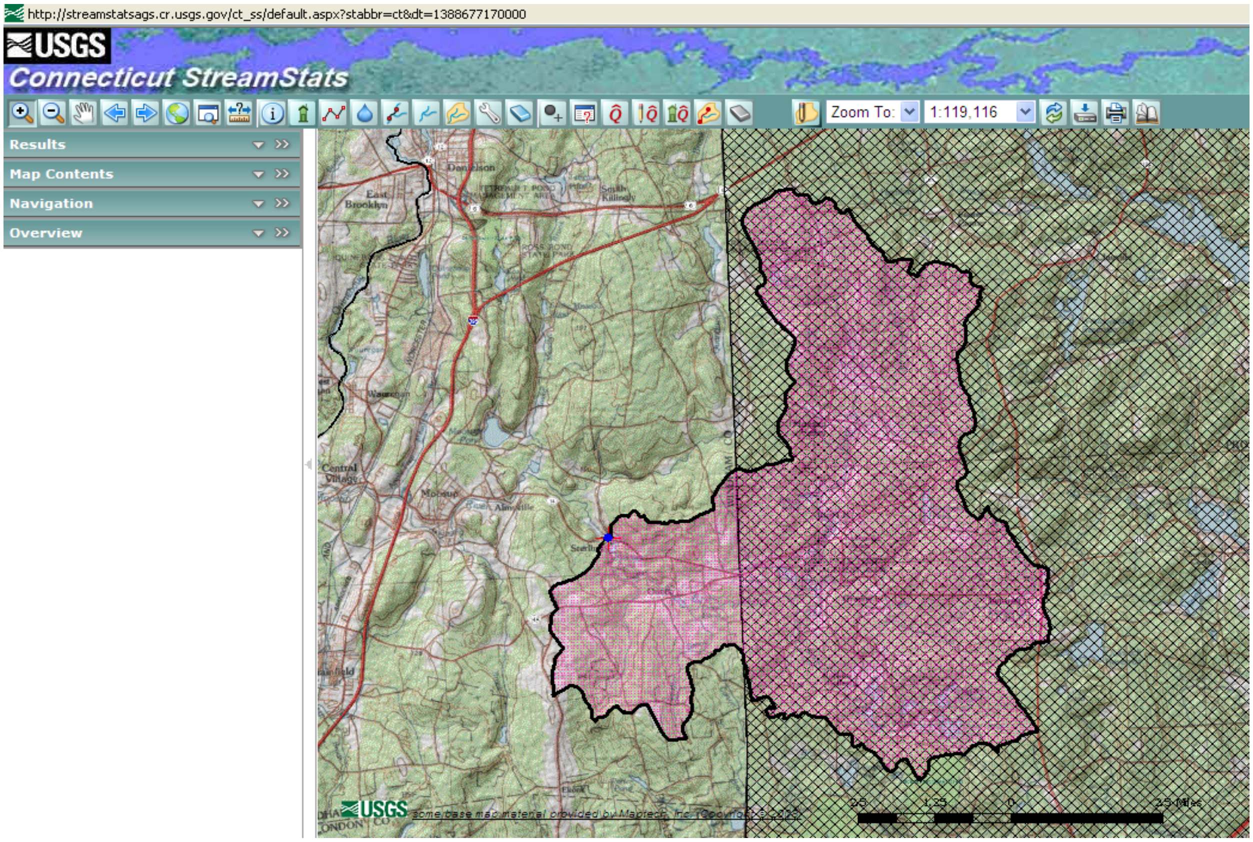
Combination of Re-Energy discharge and groundwater seep:- Lat. 41.71034º, Long. -71.82605º



Moosup River (upstream of ReEnergy and groundwater discharges):- Lat. 41.71829º, Long. -71.82999º



Drainage area of the receiving stream



USGS
Connecticut StreamStats

Print

Streamstats Ungaged Site Report

Date: Thu Jan 2 2014 08:54:54 Mountain Standard Time
Site Location: Connecticut
NAD27 Latitude: 41.7082 (41 42 30)
NAD27 Longitude: -71.8309 (-71 49 51)
NAD83 Latitude: 41.7083 (41 42 30)
NAD83 Longitude: -71.8304 (-71 49 49)
→ **Drainage Area: 42.8 mi2**

Peak Flows Region Grid Basin Characteristics

100% Statewide Multiparameter (42.8 mi2)

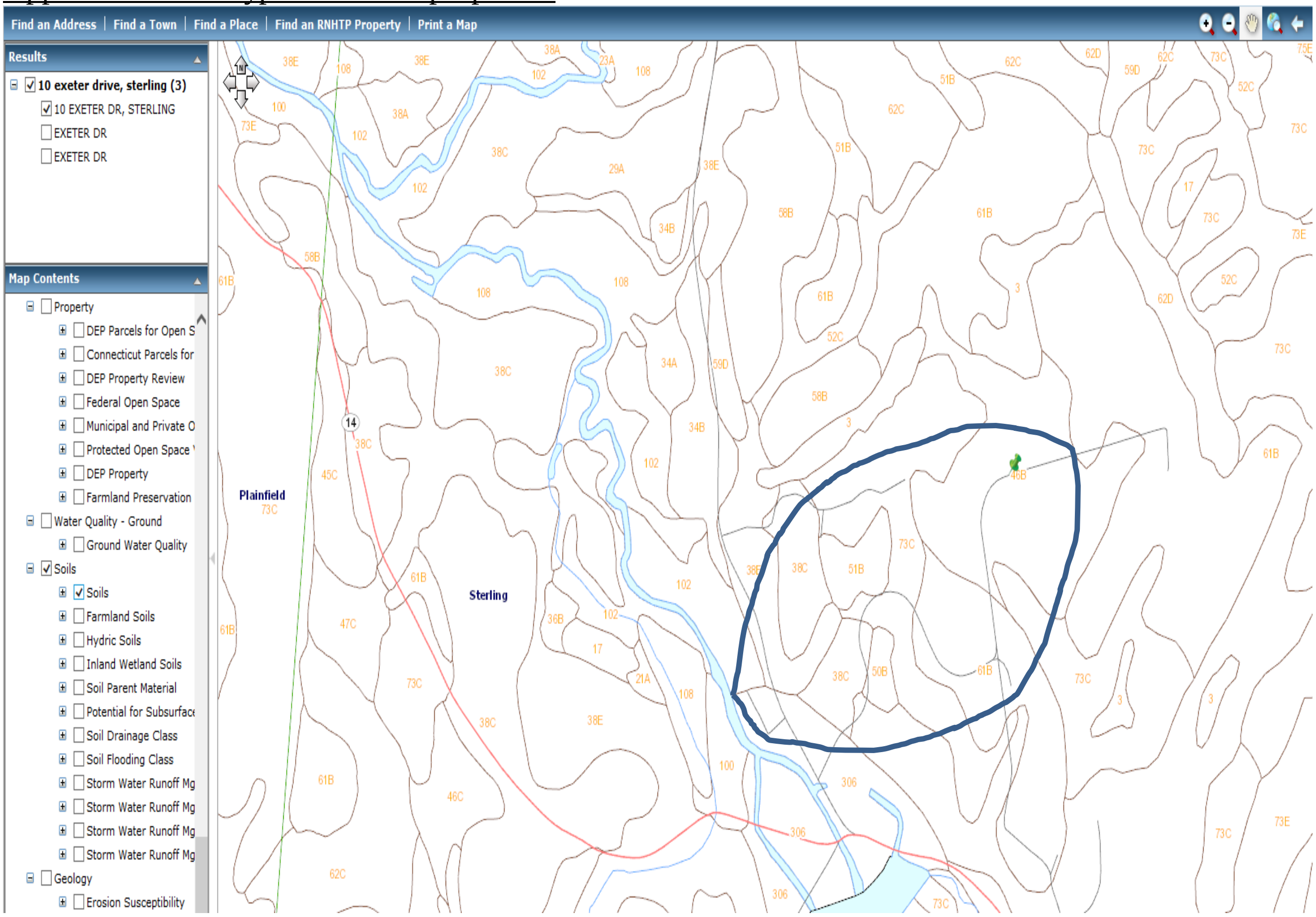
Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	42.8	1.69	715
24 Hour 2 Year Precipitation (inches)	3.5	2.95	3.82
24 Hour 10 Year Precipitation (inches)	5.2	4.15	5.53
24 Hour 25 Year Precipitation (inches)	6.5	4.93	7
24 Hour 50 Year Precipitation (inches)	7.8	5.62	8.36
24 Hour 100 Year Precipitation (inches)	9.3	6.41	9.99
Mean Basin Elevation (feet)	493.52	169	1310

SALMONID SPAWNING Basin Characteristics

100% Duration Flow 2010 5052 (42.8 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	42.8	0.92	150
Mean November Precipitation (inches)	4.7	3.48	4.93
Percent Coarse Stratified Drift (percent)	29.7	0.1	55.1
Mean Annual Winter Precipitation (inches)	4.2	3.19	4.4
Percent Wetlands (percent)	10.7	0.3	18.1
Mean Basin Elevation (feet)	493.52	168	1287

Appendix A: Soil types and their properties



Description of soil types at ReEnergy site and the surrounding areas up to the receiving stream[2]

46B:- Woodbridge fine sandy loam, 2% - 8% slopes, very stony
73C:- Charlton-Chatfield complex, 3% - 15% slopes, very rocky
61B:- Canton and Charlton soils, 3% - 8% slopes, very stony
50B:- Sutton fine sandy loam, 3% - 8% slopes
51B:- Sutton fine sandy loam, 2% - 8% slopes, very stony
38C:- Hinckley gravelly sandy loam, 3% - 15% slopes
38E:- Hinckley gravelly sandy loam, 15% - 45% slopes
102:- Pootatuck fine sandy loam
306:- Urdorthents-Urban land complex

The hydraulic conductivities of these soil types range from 4.0 µm/sec to 141 µm/sec (USDA-NRCS)[2]. Carsel and Parrish (1988)[3] have the hydraulic conductivity of sandy loam as 12.3 µm/sec. The Department will assume a hydraulic conductivity of 12.3 µm/sec, because fine sandy loam seems to be the prevalent soil type. 12.3 µm/sec falls within the hydraulic conductivity range stated in the Soil Survey of the State of Connecticut[2]. ReEnergy claims that the predominant soil type throughout ReEnergy site is glacial till. A review of five hydraulic conductivity data of till from sites at Plainfield, Sterling and Voluntown showed a range of 0.09 µm/sec to 28 µm/sec; a median of 9.4 µm/sec and an average of 11.9 µm/sec[4]. The average of the data set is comparable to the assumed 12.3 µm/sec used by the Department.

[2] United States Department of Agriculture, Natural Resources Conservation Service (2008), Soil Survey of the State of Connecticut.
[3] Carsel, R. F. and Parrish, R. S. (1988), "Developing Joint Probability Distributions of Soil Retention", Water Resources Research, 24 (5): 755-769.
[4] U.S. Geological Survey: Open-File Report 91-481 (1992), "The Stratigraphy and Hydraulic Properties of Tills in Southern New England", pp:36.